DOCUMENT RESUME

ED 042 672 80; SO 000 219

AUTHOR Morreau, Larry E.; And Others
TITLE Behaviorally Engineered Environments. Staff Papers.
INSTITUTION Upper Midwest Regional Educational Lab., Inc., Minneapolis, Minn.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
PUB DATE Mar 70
NOTE 54p.; Papers presented at the Annual Meeting, American Educational Research Association, March 1970
AVAILABLE FROM Upper Midwest Regional Educational Laboratory, 1640 East 78th Street, Minneapolis, Minn. 55423

EDRS PRICE EDRS Price MF-$0.25 HC Not Available from EDRS.
DESCRIPTORS Academic Performance, Behavioral Objectives, *Behavioral Science Research, *Class Management, Computer Oriented Programs, *Educational Environment, *Experimental Programs, *Human Engineering, Individualized Instruction, Management Systems, Programed Instruction, Systems Analysis, Systems Approach

ABSTRACT

This collection of papers represents the developmental research as well as the thrust of the Regional Laboratory's (UMREL) program. UMREL has been developing behaviorally engineered educational environments through a cross-disciplinary effort in education and the behavioral sciences. The program began with the establishment of demonstration contingency-managed classrooms for use as training and research sites. These classrooms are complete, self-contained behaviorally engineered units. Instruction is individualized and programmed; the teaching techniques, curriculum materials, and physical-social environment are designed to facilitate maximum academic performance. Based on the data provided by these classrooms, UMREL is developing a multi-faceted education eco-system. This system includes: specific behavioral objectives, preservice and inservice management technique training programs, and an educational resources center. In addition, a mechanical and/or automated computer based instructional management and analysis system contains data on: 1) curriculum material related instructional objectives; 2) the effects of various procedures on behavior for use in formulating specific objectives; and, 3) school administrative activites. (SBE)

ED042672

BEHAVIORALLY ENGINEERED ENVIRONMENTS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

50008 819

Upper Midwest Regional Educational Laboratory
1640 EAST 78th ST. MINNEAPOLIS, MINN. 55423 (612) 861-5421

An Overview of UMREL's Program

The Upper Midwest Regional Educational Laboratory is developing behaviorally engineered educational environments through a cross disciplinary effort in education and the behavioral sciences. The outcome of this program will be scientifically sound educational environments specifically designed to maximize student academic and social performance.

UMREL's program combines experience in education with the techniques of behavioral analysis, a scientific discipline based on two fundamental premises: 1) that any behavior, comprising observable and recordable events, can be measured; and 2) that the relationship between a particular behavioral event and the surrounding environmental conditions are lawful, orderly, and predictable.

Four main classes of variables determine the characteristics, including the probability of occurrence, of any behavioral event. These are: 1) the environmental conditions which precede and accompany the behavior; 2) the special properties of the response—topographical, physiological, etc.; 3) the contingencies which relate responses to their immediate consequences; and 4) the environmental consequences themselves (Daley and Wolff, 1969). A complete behavioral management program employs systematic manipulation of these independent variables to rearrange response probabilities and facilitate occurrence of desired behavior.

Behavioral Analysis in Education

Any teacher functions as a behavioral engineer when he shapes his students' behavior by establishing a stimulus environment conducive to academic performance and reinforcing that performance when it occurs. Systematic behavioral analysis in educational environments simply replaces the teacher's intuition with the methods of empirical study used by any other scientist: controlled observations of events and their surrounding environments. Scientific evidence is used to design procedures which have a demonstrable effect on the student's behavioral repertoire.

The development of techniques employing frequently occuring classroom behavior as direct reinforcement for appropriate academic performance is particularly significant to classroom management.

Major contributions in this area have evolved from the work of David Premack, who developed a reinforcement concept called the Differential Probability Principle which states: "...for any pair of responses, the more probable one will reinforce the less probable one" (Premack, 1965, p. 132). An important corollary to this principle is the Indifference Principle, which states that the reinforcement value of an event is independent of the parameters producing response probability, i.e., any behavior can be used as a reinforcer of any other lower probability behavior.

Using Premack's principles, only each student's most frequently emitted responses must be identified for use as reinforcers, and reinforcing events may be easily arranged as consequences for behavior. Any mechanical dependency on candy or trinkets as reinforcers is eliminated.

With techniques based on Premack's principles (known also as contingency management techniques), Lloyd Homme effectively modified the behavior of nursery school children (1963), adolescents (1964), pre-school non-English-speaking Indian children (1963), and young non-talking retarded children (1963). He also successfully applied contingency management to school-like tasks (1964, 1965) and problem behavior (1963, 1965).

Daley, Holt, and Vajanasoontorn (1966) investigated a technique in which high-probability

responses were pictured in a menu (Addison and Homme, 1966). Several ways of managing contingencies of high and low probability response classes, and strengthening or developing behavior important to the academic or acculturation processes of trainable mentally retarded were examined.

Following this study, Friar (1969) showed that it is possible to engineer increases and decreases in both academic and non-academic response classes with standard materials. In another experiment with moderately retarded children, Daley and Holt (1969) showed that the menu of activities could serve as a device for fading low probability task behavior into high probability reinforcing behavior, thus greatly enlarging the number of reinforcement events which the educator can use in his instructional management programs.

Laboratory Program

UMREL's work on the development of behaviorally engineered educational environments began with the establishment of demonstration contingency-managed classrooms for use as training and research sites. These classrooms, which were designed to make use of existing facilities in a typical schoolroom, are complete, self-contained behaviorally engineered units. Instruction is individualized, and the teaching techniques, curriculum materials, and physical-social environment are designed to facilitate maximum academic performance.

On the base provided by these demonstration classrooms, the Laboratory is developing a multi-faceted behaviorally engineered and environmentally oriented educational system. A finished system, suitable for adoption by school districts across the country, will have:

a) specific behavioral objectives based on useful evaluative criteria for all components of the instructional system;
b) educational pre- and in-service training in management techniques and pupil data based instructional programs;
c) a curriculum objectives bank available to all participants;
d) an educational resources center, mechanical and/or automated computer based instructional management, with accompanying reorganized staffing of professional educators, etc.

The basic dependent variable studied in the Laboratory's developmental work is the student's academic performance. All the other variables in the learning environment—class and teacher behavior, reinforcement procedures, curriculum materials, organizational characteristics of the school, and even the political and social conditions in the community—are investigated to reveal their relationship to student performance. Changes in the variables are evaluated by the concrete gains or changes in student performance which result.

The research findings contribute to improved design of instructional practices, curriculum materials, and the educational environment as a whole, as well as to the development and validation of a new training program for school personnel, thus improving the adoption process.

To correlate all the information generated by this program and to maintain the characteristics of the engineered environments, the Laboratory is developing an ecological maintenance system which will provide principally procedural information relevant to several types of environments and a pupil-based source data bank useful to practitioners in the field.

One division of this information/maintenance system includes a bank of instructional objectives related to currently available curricular materials with objectives collected for each subject area.

A second division contains actuarial data concerning the effects of various procedures on behavior. This information is stored in the form: "Given sets of conditions, X; with Y rates of response; Z procedures will produce these quantitative consequences on Y." Selected statistical analyses are made from this bank, and practicing educators and researchers may query the bank about the most effective and efficient methods to reach specific educational objectives.

A third division in the system will store procedural and data base information on school administrative activities like cost accounting methods, record-keeping operations and material inventory and allocation.

In addition to developmental work within UMREL, cooperative relationships have been established with state universities, colleges, state departments of education, local school systems, and private industry to support the work the Laboratory has undertaken.

The Laboratory provides the institutional and skill/knowledge base for program activities. Outside expertise is brought in when needed to augment the Laboratory staff.

References

1. Addison, R. M., & Homme, L. E. The reinforcing event (RE) menu. NSPI Journal, January, 1966, 5(1).

2. Daley, M. F., & Holt, G. L. Systematic probability reversal and control of behavior. Prepublication manuscript, 1969.

3. Daley, M. F., Holt, G. L., & Vajanasoontorn, C. Reinforcement menus in the instruction of mentally retarded children. Proceedings of Far West Laboratory for Educational Research and Development, November, 1966.

4. Daley, M. F., & Wolff, P. C. A functional analysis of behavior. In S. Fletcher, & F. Berg (Eds.), The hard of hearing child: Clinical and education management. New York: Grune and Stratton, 1970.

5. Friar, C. M. Behavior modification of trainable mentally retarded children. (Unpublished doctoral dissertation, Utah State University), 1969.

6. Homme, L., deBaca, P., Devins, J., Steinhorst, R., & Rickert, E. Use of the Premack principle in controlling the behavior of nursery school children. Journal of the Experimental Analysis of Behavior, 1963, 6, 544.

7. Homme, L. E. Technical progress report No. 1, a demonstration of the use of self-instructional and other teaching techniques for remedial instruction of low-achieving adolescents in reading and mathematics, October, 1964. Submitted to U. S. Office of Education.

8. Homme, L. E., & deBaca, P. Contingency management of the psychiatric ward. Unpublished manuscript. Westinghouse Electric Corporation Research Laboratories, January, 1965.

9. Homme, L. E. A system for teaching English literacy to preschool Indian children. Westinghouse Research Laboratories Contract 14-30-065001506. Bureau of Indian Affairs, Final Report, October 11, 1965, 1-15.

10. Premack, D. Reinforcement theory. In David Levine (Ed.), Nebraska symposium on motivation. Lincoln: University of Nebraska Press, 1965, 123-188.

"PERMISSION TO REPRODUCE THIS COPYRIGHTED MATERIAL BY MICROFICHE ONLY HAS BEEN GRANTED BY
DR. MARVIN F. DALEY
TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE U.S. OFFICE OF EDUCATION. FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER."

BEHAVIORALLY ENGINEERED ENVIRONMENTS

Staff Papers

Copyright 1970 UMREL

This symposium describes the central features of the Laboratory's research and development activities. The Laboratory's management strategy is reflected in the symposium's preparation and production, which combined many interdependent functions to reach a common objective. Liaison with AERA headquarters was maintained by David N. Evans and Robert G. Publicover. Content Selection was made by Marvin F. Daley and William M. Ammentorp. Symposium design and programing strategy were developed by Lanny E. Morreau and Marvin Daley. Production of the Symposium was coordinated by Robert H. Pinney and Lanny Morreau. Manuscript editing and preparation was done by John G. L. Mihelic, Mary Mihelic, and Robert Publicover. BCSI participation was coordinated by Marvin Daley, Milton C. Hillery, and Robert G. Packard. Assistance in the development of programed instructional devices was provided by Joe H. Harless.

DAVID N. EVANS
Executive Director

MARVIN F. DALEY
Deputy Director - Program

Thomas E. Caldwell
Donald J. Christensen
Rosemary L. Christensen
Gary G. Dodge
Brian Fitch
Judith Fitch
Mary E. Fullmer
Douglas M. Gross
Karen J. Hess

WILLIAM M. AMMENTORP
Deputy Director - Operations

Dean A. Honetschlager
Dennis L. Jacobsen
Abraham Kidane
Barbara K. Long
John C. Maxwell
John G. L. Mihelic
Lanny E. Morreau
Craig R. Olson
Robert G. Packard

WILLIAM J. HILL
Deputy Director - Administration

Paul R. Petrafeso
Robert H. Pinney
Patricia A. Pool
Robert G. Publicover
Rodney L. Snyder
Robert L. Williams
Robert A. Wininger
W. Scott Wood

Presented at the American Educational Research Association Convention, Minneapolis, March 1970. Published by the Upper Midwest Regional Educational Laboratory, a private non-profit corporation supported in part as a regional educational laboratory by funds from the United States Office of Education, Department of Health, Education and Welfare. The opinions expressed in this publication do not necessarily reflect the position or policy of the Office of Education, and no official endorsement by the Office of Education should be inferred.

This collection of papers represents the developmental research as well as the thrust of UMREL's program. Our primary objective, the design and implementation of behaviorally engineered environments, requires the investigation of each component in our educational eco-system. As such, these papers are organized around five basic areas of research: 1) behavioral objectives; 2) programmed instruction; 3) behaviorally engineered classrooms; 4) educational ecologies and; 5) systems analysis and measurement.

Contents

5 **A Curriculum for Every Child**
Lanny E. Morreau

9 **Full-Service Banking of Objectives**
Robert A. Wininger and Robert G. Publicover

11 **English Objectives: Nonstandard Dialects**
John C. Maxwell, Karen J. Hess and Barbara K. Long

13 **Teachers for Tomorrow**
Dennis L. Jacobsen

15 **Planning by Objectives: Workshops that Work**
Craig R. Olson and Rosemary L. Christensen

17 **Behavioral Management through Programed Instruction**
Marvin F. Daley and Lanny E. Morreau

19 **Pre-Schoolers Quickly Learn to "Tell Time"**
Mary E. Fullmer and Robert G. Packard

21 **Behavior Observation Guide**
Donald J. Christensen and Robert W. Hendon

23 **Does "Behavioral Management" Turn People On?**
Dean A. Honetschlager and Gary G. Dodge

27 **Critical Events in Implementing Behaviorally Engineered Classrooms**
Dean A. Honetschlager and Robert H. Pinney

29 **Student Involvement in RE Selection**
Gary G. Dodge

31 **Happiness is a Beautiful PPDF**
Patricia A. Pool and Chu pin Chu

33 **Videotape as a Classroom Observational Tool**
W. Scott Wood and Atlen L. Sova

35 **A Specific Educational Role for the Classroom Aide**
Paul R. Petrafeso

37 **Prerequisites for Systems Analysis in Education**
William M. Ammentorp, Marvin F. Daley and David N. Evans

39 **Inservice Credits as Reinforcement for Teacher Behavior**
Rodney L. Snyder

41 **Establishing Relationships for Research-Based Development in Schools**
Dean A. Honetschlager and David N. Evans

45 **Volunteer Programs?**
Robert L. Williams

47 **Analysis in Elementary School Education**
Brian Fitch

49 **Schools, Systems, Machines**
Milton C. Hillery, Marvin F. Daley and Robert G. Packard

53 **Programing for Data Recording**
Robert G. Packard

57 **Information Search and Recording System**
Judith P. Fitch, William M. Ammentorp and Marvin F. Daley

59 **ERIC: A Component of the Information Search and Recording System**
Judith P. Fitch

A Curriculum for Every Child

Lanny E. Morreau

Because effective educational methods will always result in the modification of student behavior, the most important criteria for evaluating teaching strategies is change in the student's behavior. In assessing the quality of instruction, in terms of both methodology and materials, the measurement index must be based on the learner's terminal behavior.

The precision necessary for evaluation of instructional outcomes is provided by *behaviorally* written instructional objectives which include:

1. the specification of "the learner" as differentiated from a class or group of learners,
2. a specific measurable response which the learner will emit,
3. a delineation of the stimulus conditions under which the response will occur,
4. a specific statement on the frequency, duration, or quality of the response,
5. a criterion level at which the performance will be considered successful.

The behaviorally written instructional objective not only provides a measurement index for the evaluation of pupil progress, but it also serves as a guide for teacher decision-making. Given a set of complete, sequentially arranged (omitting no pre-current skills necessary to the terminal behavior) instructional objectives, the teacher has all the information necessary for planning and designing procedures, materials, and measures.

Few complete instructional objectives exist for most subject-matter areas, and for subjects like social studies and science, teachers have consistently been left on their own to develop the necessary "units."

To help teachers with this problem, UMREL has developed a guide for planning individualized lessons. The guide first directs the teacher to narrowly define each topic, (see model of *Individualized Lesson Format*, fig. 1.), and then divide the topic into its major concepts. These concepts are numbered, and then restated as educational objectives–operational descriptions of a general class of student behavior which will represent subject-matter skill/knowledge. Based on the educational objective, the teacher can write and evaluate her instructional objectives.

The UMREL guide provides for abbreviated objectives. Action can usually be specified as a single word, the measure with a number and a noun, the conditions with a short phrase, and the criteria with a percentage. Instructional objectives written in this format can be easily evaluated against the educational objective which has been paired with the concept on the guide itself: Does the objective, if met, indicate the subject matter expertise which is indicated in the educational objective? If not, how can it be modified?

After preparing a sequence of instructional objectives for each educational objective, the teacher is directed to evaluate the objectives internally: Are they in logical sequence? Have any necessary for continued progress through the program been omitted? Have difficult discriminations or generalizations been dealt with? Are any objectives unnecessarily redundant, is each relevant to the student's terminal behavior?

The teacher writes and evaluates the complete set of instructional objectives for each major concept using these criterion questions. She then designs her lesson plan using these objectives as guides. For each objective the teacher must design or select procedures and activities which will lead to the terminal behavior specified in the objective. She can evaluate her decisions by answering three questions about each procedure or activity: (1) Is this procedure/activity relevant to the terminal response? (2) After completing this procedure/activity,

will the student emit the specified response? (3) Does the procedure/activity contain generalizations leading to the learners emitting the response under the conditions specified?

Having correlated specific activities and procedures to the terminal response of the learner, the teacher identifies the materials needed by listing associated materials under each procedure/activity. The UMREL guide directs the teacher to ask these questions: What specific materials are needed to match this procedure/activity? Does *this* material, (e.g., student desk maps, programed science units) lead to the terminal response specified in the objective? Is this material available? If so, from where? If not, what can I substitute?

As previously noted, the teacher must use the learner's response as the measurement index when evaluating her methodology and her materials. The content and structure of the criterion check which she prepares must be specifically related to the instructional objective. She should ask: Is the response emitted on the criteria-check the same response as specified in the objective? Is the structure of the criteria-check items consistent with the conditions stated in the objective? Is the quantity, duration, or quality of the response required consistent with the measure? Will the meeting of the specified criteria on these items indicate the subject matter repertoire indicated in the educational objective?

The final section of the guide provides the teacher with an on-going evaluation procedure. If students fail to meet the objective, she can note the following information: To what degree did the learner fail to meet criterion? Were the specific procedures, activities, and materials used not tied precisely enough to the objectives (reassess)? If not, what other procedures, activities, or materials can be implemented to correct for this?

Using this guide, in conjunction with her continuous reevaluation, the teacher is able to formulate individualized lesson plans in a precise, functional manner.

Figure 1: MODEL OF INDIVIDUALIZED LESSON FORMAT

Major Concept _____

Objective No. _____

Objectives

1. Action: _____
   Measure: _____
   Condition: _____
   Criteria: _____
2. Action: _____
   Measure: _____
   Condition: _____
   Criteria: _____
3. Action: _____
   Measure: _____
   Condition: _____
   Criteria: _____

Procedure and Activity:

_____

_____

_____

Materials Needed:

_____

_____

_____

Student--Evaluation Procedure:

_____

_____

_____

Teacher Evaluation of Lesson:

_____

_____

_____

Full Service Banking of Objectives

Robert A. Wininger and Robert G. Publicover

A system was needed for teachers in UMREL's behaviorally engineered classrooms so they could 1) clearly define each response and its specific properties, and 2) select specific stimulus events to which the learner could respond. In response to this need UMREL developed a storage and retrieval system (bank) for sequentially arranged instructional objectives.

Our banking system, which relies in part on the work of people like Robert Gagne, Robert Glaser, Robert Mager, and James Popham, has four major characteristics: 1) all objectives are sequentially arranged, 2) all objectives are complete (including student-action-measure-condition-criteria), 3) each objective contains instructions for teacher use of the objective itself, and 4) specific units of curriculum material are tied to each objective.

Sequencing Objectives

The sequential arrangement of objectives serves several major functions: 1) it assures that required generalization will occur, 2) it directs the pupil toward increasingly complex discrimination, 3) it prevents the omission of prerequisite skills for meeting any terminal objective, and 4) it enables the teacher to place students precisely within a body of objectives. These functions are assured by including in the system a curriculum area identifier (such as "reading"); identification of the major and sub-concepts, the content level or grade levels of the materials, and the identification number for each objective. These filing categorizations enable the teacher to find appropriate objectives manually, but the system is also compatible with an automated storage/retrieval/referencing system.

Complete Objectives

The complete objective gives the teacher a precise statement of what is expected from the student in measurable, behavioral terms. A complete instructional objective by our definition contains five major components: the student, an action, the conditions, the measure, and the criteria. The *learner* is specifically referred to within the objective sequence to differentiate these objectives from the traditional objective designed for assuring "class" or "group" outcomes. The *condition* is designed to communicate the parameter within which the student will be working. The *action*, expressed in precise verb forms, provides for the measurement of pupil responses. The *measure* states the numerical quality, quantity or duration of responding. The *criteria* establishes the level at which the student must be able to respond in order to proceed within the sequence of objectives.

Teacher Instructions

These instructions provide teachers with: 1) procedures for the evaluation of student performance, 2) procedures for introducing instructional materials, and 3) sample problems from those materials. The evaluative procedure provides answers to such questions as, "Should I use a curriculum-embedded test for this objective?" or "Should I test orally?" The instructions for teachers communicates special requirements for the teacher as she prepares to use a specific objective.

Curriculum References

The curriculum references provide the teacher with materials designed to meet a specific associated objective. Several different sets of curriculum materials are given for each objective to provide data for the continuous testing and modification of curriculum materials.

Each of these characteristics is essential when structuring a banking system for instructional objectives. Sets of complete sequentially arrang-

ed instructional objectives must be functionally tied to the performance of the individual. The teacher must have a precise and complete statement of the objective. Suggestions for materials must be available, though the system must be flexible enough to allow the teacher to introduce variations. The format should make sequencing clear and furnishes an automatic check of performance. And, for our system, the format is compatible with computer tabulation and manipulation of progress data. UMREL has developed such a system.

MODEL OF INSTRUCTIONAL OBJECTIVES FORMAT

Instructional Objectives for _____

Major Concept	Sub-Concept	L* or Grd.	IO No.	INSTRUCTIONAL OBJECTIVE			Evaluative Procedure	Instruc. for Teacher	Sample Prob.	Materials Reference
				Condition	Action	Measure				

* Level or Grade

English Objectives: Non Standard Dialects

John C. Maxwell, Karen J. Hess and Barbara K. Long

The control of standard English by speakers in appropriate contexts has been a long-standing objective of elementary and secondary instruction, but a host of apparently irrelevant teacher behaviors has arisen in attempts to meet this objective.

In approaching this major instructional problem, the Laboratory first sought to define the relevant behaviors of teachers which would permit them to individualize instruction (and therefore focus instruction) for the improved control of regionally-standard English among students.

After a thorough study of the literature on the subject, the following target behaviors were identified. At the end of the UMREL training program, teachers would be able to:

1. Demonstrate through written tests a minimal understanding of ten basic concepts about dialects—their origins, their nature, and their significance to their speakers.

2. Secure, on audio tape, speech streams of a specified (i.e., careful) type of a sufficient duration and technical quality to provide a means for detailed analysis.

3. Write a broad phonetic transcription of the speech streams secured (or, more accurately, those subparts of such speech streams which are nonstandard for the speaker's region).

4. Classify the nonstandard features according to broad categories and according to specific sub-categories.

5. Apply data on linguistic and social significance of nonstandard features, and data on the frequency of the student's use of those features to arrive at a critical and individualized curriculum on usage for the student.

6. Select appropriate teaching materials which can be used on an individual basis, and "bank" reference cards pertaining to those materials so they can be easily retrieved for application to individuals.

While the training program to bring teachers to criterion level in these behaviors is being developed further, work has begun in creating a bank of behavioral objectives in usage and dialect, stated for students. At the present time, curriculum objectives are stated as topics (e.g., "verb agreement") or undifferentiated negative statements (e.g., "does not use *is* with singular subjects). In rewrite, the objectives will be stated affirmatively and will specify the contexts in which the behavior should occur.

Further work will be done in the Laboratory to secure and catalog instructional materials pertinent to the bank of instructional objectives on usage. These materials can be then matched with the objectives and applied by the teacher to those students shown by the teacher's diagnoses to need work on the behavior.

When application of the student training system is being conducted, it is quite probable that the training program for teachers will be modified. Thus, the hypothesized set of behaviors indicated for teachers will be modified according to their known importance in changing the behavior of students.

Teachers for Tomorrow

Dennis L. Jacobsen

Southwest Minnesota State College in Marshall, Minnesota, has recently begun a teacher-education program based on many of the educational concepts UMREL is developing. The Laboratory is working closely with the college in this program, which is designed to prepare teachers to implement an individualized curriculum based on instructional objectives. Teachers are being trained in the skills of educational behavior management–contingency management, principles of behavior objectives, behavioral analysis of learning problems, etc. The Laboratory has provided Southwest State with directions in the application of instructional objective principles, and format, design, and development guidelines for the instructional objective materials.

The Southwest State College project is quite important to the long-term success of UMREL's developmental program. While in-service teacher training given in Laboratory workshops and seminars is satisfactory for present developmental work, these small-group training programs would not be feasible for training the large number of teachers necessary for widespread implementation of UMREL designs. By providing valuable information on the costs and procedures necessary for pre-service teacher training, the Southwest State effort will help in planning for eventual initiation of UMREL oriented teacher education programs at other teaching institutions.

In addition to these long-range benefits, Southwest State also provides important feedback data on the use of UMREL products. An UMREL Contingency Management training module will soon be used for teaching application of CM principles to classroom situations, and the highly-developed *Dialects and Dialect Learning* self-instructional module will be included in Southwest's project. In the future an UMREL-developed precision teaching unit may also be used.

In all these areas, the UMREL-Southwest State College liaison is producing substantial payoffs for both institutions.

Planning by Objectives: Workshops that Work

Craig R. Olson and Rosemary L. Christensen

Workshops seldom change the behavior of those who attend them, usually because workshop organizers fail to specify the outcomes they desire for the participants.

The Laboratory staff attacked this problem during a recent training session conducted for workshop leaders from the National Indian Education Conference. The workshop leaders, each scheduled to lead 90-minute sessions during the week of the Indian Education Conference, were trained primarily in the techniques of planning by objectives.

During the UMREL training, workshop leaders wrote objectives not only for workshop participants, but also for themselves as workshop leaders. As an aid in acquiring the skills required for writing the objectives, before the training session each workshop leader received a packet of materials containing a rationale for using objectives, a guideline for preparing objectives, examples of properly written objectives, and a list of objectives which could be used in the workshops.

The training session itself was devoted to reviewing procedures for writing objectives and to actually writing objectives for each workshop.

The objectives prepared by the leaders did not meet all the technical requirements, but they were usually reasonable approximations of what was desired; any problems encountered in using the planning by objectives approach in conducting the workshops was unrelated to the leaders' objective writing techniques.

During the training session several leaders did not feel sufficiently competent to decide by themselves which objectives were essential. They thought it was presumptuous to establish objectives without factual information about existing skills and knowledge of the participants. In this situation, the only solution seemed to be for workshop leaders, as experts in Indian education, to make the best estimate they could of capabilities and needs of individuals attending their workshops. A better, though more difficult solution would have been to obtain from participants, through a questionnaire or survey, an indication of what they wanted to accomplish by attending a particular workshop.

A second problem was several leaders' fear of preventing contributions from participants by structuring the workshop too tightly. They thought that if the entire time was spent accomplishing objectives that they alone had defined, they would effectively prevent any spontaneous contributions from participants. This limitation is not as detrimental or as difficult to overcome as it first appears. Planning by objectives doesn't mean that workshop participants remain passive. On the contrary, this approach specifies only that persons participate in a deliberate, planned manner so that desired outcomes can be accomplished.

One problem encountered during the actual workshop sessions involves the control of participant behavior. The workshop leader has no really effective means of controlling every type of behavior during the session. In one workshop, an individual who was unwilling to abide by accepted conventions and procedures was able to disrupt the planned activity of the entire group. If a planning by objectives approach is to succeed, some way of insuring the cooperation of all participants must be developed.

In general, workshop leaders responded favorably to the training session. In assessing the session after they had completed their workshops, many leaders felt that the largest dividend resulted from being required to think in behavioral terms about what they wanted participants to accomplish. Many leaders also felt that this

approach made organizing their workshops easier and more efficient, and several participants remarked that having a list of objectives to be accomplished in each workshop they attended made the session more productive for them.

Planning workshops by using specific objectives presents no problems that cannot be successfully solved or mitigated. The question remains, however, whether benefits gained from approach are worth the time, effort and cost expended. As in all cases of programed instruction, some easily learned strategies will have to be developed for assisting the workshop participant in generating his own objectives. Once this is done, it will then be possible to access the relative value of this approach.

Behavioral Management through Programed Instruction

Marvin F. Daley and Lanny E. Morreau

Techniques and principles of behavior management are rapidly being extended into the field of education. One of these principles which is particularly applicable to classroom management, states that any behavior, at the time it is of higher probability, can be used to reinforce a lower probability behavior. Using this principle, a teacher can arrange a classroom environment so a student's access to high probability activities (reinforcing events) is contingent upon the completion of low probability activities (task behaviors). Through this management of contingencies a teacher can increase the emission of selected task behaviors.

At the time that this research was initiated, there was no single source where teachers or teacher candidates could gain a functional knowledge of the principles and techniques involved in the management of contingencies. A procedure with the following characteristics was needed for the training of teachers: 1) it would lead to the specified terminal behaviors on the part of the teacher; 2) it would be cost-effective; and 3) it could be easily disseminated.

The first step in the development of a teacher training program was to isolate the basic principles of contingency management. The criteria for selection was based on responses to two questions: 1) Which principles does the teacher have to know in order to successfully manage contingencies? 2) To what degree is it necessary for the teacher to have a pedagogical knowledge of the data base underlying these principles? A decision was made to design a program using a series of application rules with minimal emphasis on the theoretical data on which these rules were based. The decision was also made to structure these principles in a programed format. This decision satisfied our cost-effectiveness and ease of dissemination requirements, while providing an empirical procedure for the design of a training program.

A criticality index was established for the evaluation of each principle in terms of its behavioral significance to management behaviors. The principles were then grouped in terms of 1) the generalizations which must occur as the student proceeds towards a higher degree of simulation (classroom practice) and 2) the interaction of any of these rules or applications which might inhibit or promote continual progress towards the terminal response. Based upon these generalizations and discriminations, the principles were systematically arranged to facilitate the students' retention of the information.

This deductive design was adapted for use in programing the sequentially arranged principles:

1) Presentation of a principle;
2) Presentation of an example of the principle;
3) Presentation of a question pertaining to the principle with several alternative responses;
4) Presentation of the correct answers to the question with a brief discussion;
5) Presentation of a problem related to the principle; and
6) Presentation of criteria by which the students could evaluate his responses to the problem.

The teacher training program developed around this model included: 1) a programed text; 2) videotaped samples of student behavior for practice in applying the selected contingency management principles; and 3) a series of progress checks with which the student could evaluate his performance in the program.

The criterion behavior on the part of the learner, the teacher or the teacher-candidate, was specified as follows: 1) Upon completion of the program, the student would correctly write the selected principles of contingency management when presented with 20 open-ended questions pertaining to these principles; 2) Given a videotaped sample of pupil behavior, the student would write a behavioral prescription which would include a specific low probability behavior, a specific high probability behavior, and the arrangement of a response contingency.

The ultimate test of any program rests in the measurable change in the behavior of the learner. In this case, the primary question was whether a teacher could successfully establish and maintain a behaviorally engineered classroom after having completed the program. Specifically, she should be able to:

a) Select, write, or modify instructional objectives for each area of the curriculum.

b) Select, measure, and record specific student responses.

c) Extrapolate data from the recording sheet to a graph and interpret behavioral changes.

d) Specify present level of task performance and increase on a systematic basis.

e) Establish performance criteria for each area of task behavior.

f) Select high probability behaviors for an individual student based upon her observation and measurement of his behavior.

g) Design and structure a classroom environment to include three distinct areas: TASK AREA, PROGRESS CHECK POINT, and RE AREA.

h) Arrange a contract including specific Reinforcing Events which will be presented contingent upon specified task completion.

The composite program was first tested in summer 1968 with a population of 22 Special Education teachers, then modified on the basis of teacher feedback during the training session, and on the basis of subsequent change in the teachers' behavior in the classrooms. Other testing populations have included primary and secondary teachers in both rural and urban classrooms.

The change in teacher behavior represented by their classroom management skills supports the premise that cost-effective programs can be developed for teacher training through the use of programed instructional strategies.

Pre-Schoolers Quickly Learn to "Tell Time"

Mary E. Fullmer and Robert G. Packard

A design which focuses on the ecology of the classroom is generally preferable to one which attempts to change the behavior of teachers and students. But when a specific classroom problem seems to call for combined modifications in both ecology and behavior, an emphasis on ecological change usually enhances the effectiveness and efficiency of the strategy.

For example, we wish to collect continuous time data for each student's performance on microtasks. We know:

1. Every classroom has a wall clock.

2. "Time-telling" skills are already a part of the entering behavioral repertoire of all teachers and most students beyond the second grade. By using the students' skills, the teacher's time is available for other activities more appropriate to her role and training.

3. Individualized programed curriculum materials are available in the UMREL program to teach the complex time-telling skills to students by the end of first grade.

4. We also want time data on the performance of kindergarten and first grade classes and of new students entering the system at other levels, including their time data on their progress through a complete time-telling sequence.

Specified in this way, the problem can be solved by introducing a digital clock ($10) into these classes, accompanied by a minimum instructional program with the following sequence of objectives:

1. The student is able to fill in mark-sense dots quickly (3 seconds per mark) with acceptable quality and density. This is taught by first demonstrating and contrasting acceptable and unacceptable marks and then prescribing several practice sessions on sample grids and evaluating in terms of quality, density, and speed.

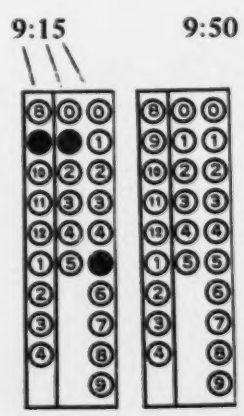
2. The student is able to match numbers one through twelve to sample with 100% accuracy. This is taught using a demonstrate-prompt-release procedure of the following type:

	5	
3	0	
1	1	12
2	2	8
(3)	3	9
4	4	10
5	(5)	11
6	6	12
7	7	1
8	8	2
9	9	3

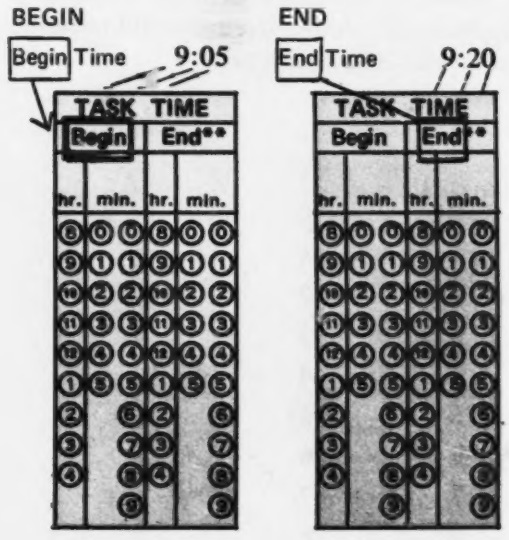
3. The student is able to match three columns of the same numbers with 100% accuracy. The same procedure is used, as for example:

1	2	3
8	0	0
9	1	1
10	(2)	2
11	3	(3)
12	4	4
(1)	5	5
2	6	6
3	7	7
	8	8
	9	9

10	5	5
8	0	0
9	1	1
10	2	2
11	3	3
12	4	4
1	5	5
2	6	6
3	7	7
	8	8
	9	9



4. The student is able to discriminate "Begin" columns and "End" columns taken from the PPDF (see sample frames below), locate these columns when given a complete PPDF, and execute and sequence all these skills with 100% accuracy during a microtask cycle.



The objectives are prescribed in a series of microtasks, each following by evaluation and RE. The material is presented on worksheets and on actual PPDFs, and supplementary practice problem-sheets (where necessary). Each microtask is introduced by verbal instructions. The size of the microtasks and the rate of progress through the sequence of objectives varies with the student's demonstrated ability with the skills. Preliminary results with 39 kindergarten students indicates that the program fulfills the objectives in from 30 minutes to 2 hours of class time.

Behavior Observation Guide

Donald J. Christensen and Robert W. Hendon

Teachers are in the behavior-changing business and therefore must know when behavior has been changed. They must be able to observe the student actions and report objectively to themselves and others. One test of objectivity is reliability: observers must report the same thing when looking at the same event.

Forty-five observation systems were surveyed and only four schemes were found which attempted to record observable behaviors of subjects. The majority of studies and procedures surveyed were subjective approaches which required the observer to classify behavior in what one might call covert behavioral description. Those designs which required that the observer infer cognitive or socio-emotional conditions in the subject could not meet the requirements of reliability and communicability of measures. They told more about the bias of the observer than about the behavior of the subject.

After a thorough review of the literature and extended discussions with the Laboratory staff, it was concluded that any observational system which might be developed should be objective and should incorporate the teacher as an observer of pupil behavior. Existing designs were criticized because they did not provide the teacher with useful means to secure adequate behavioral data about pupils.

An objective of this project was to develop an approximation to mutually exclusive and exhaustive observation categories of pupil performance through the use of videotaped classroom behavior, for training observers in recording and observing pupil behavior. If teachers are trained to differentiate behavior emitted by children in the classroom, they will then be able to apply such skill/knowledge in the classroom after the training period. Videotape of actual classroom behavior results in very realistic simulations. Having had such training, teachers should not infer qualities or traits that are founded in dubious cognitive structures.

Once the categories of behavior were established, the conceptualization was further advanced by specifying what constituted an observational skill. The behavior called "observing" was defined as a response in the presence of a definable environmental event. The environment was divided into home, school, and not home or school. The area of study was further limited to the school, and within that environmental sector, to the classroom. Environmental conditions and response categories were dichotomized into static/mobile, interaction/non-interaction, self-initiated/other-initiated, with peers/with adults, audible/inaudible. A matrix was devised with environmental conditions on the vertical axis and response categories on the horizontal axis. Subjective and inferential components were removed from the matrix. Since all possible responses could not be listed as a guide for teachers, ninety-one were selected as encompassing practically all classroom behaviors.

To train observers to identify and record behavior according to developed categories, two ten-minute videotapes showing samples of school children's classroom behaviors were assembled. The tapes and the observation guide were tested with several groups and a refined guide was produced.

To test reliability, the refined guide was tested. A buzzer was sounded to focus the attention of observers on a behavior. At the first check, observers were instructed to report the behavior emitted just before the buzzer sound. This strategy yielded spurious results and was abandoned in favor of recording behavior evident at the sound of the buzzer. In the final observations, reliability of .78 among 24 observers was measured by the Kuder-Richardson and Hoyt method.

The study is an example of a successful attempt to develop a recording system as a first step toward training teachers to observe objectively their pupils' behavior. Videotaped behaviors provide a close analog and are accepted by observers as realistic simulations. Children soon ignore the presence of a camera in the classroom, and their behavior becomes natural.

It was recommended that the observation guide be revised after field-testing with teachers and that further studies be undertaken to determine if the behavior of teachers, administrators, and other school personnel can be measured by this method.

Does "Behavioral Management" Turn People On?

Dean A. Honetschlager and Gary G. Dodge

The Problem

When the Laboratory began its present program, there was little evidence about educators' responses to words which describe behavioral engineering practices, but experiences of the Laboratory staff and reports in the literature implied that certain words such as behavioral engineering, management, reinforce, etc., might prompt responses which interfere with the acceptance of ideas. As the Laboratory continues to develop behavioral engineering training procedures, it is important for it to know: (1) do educators respond differentially to specific words which are associated with behavioral engineering? and (2) are there differences in responses to these terms among different educator groups; i.e., teachers, school administrators, college professors of education?

The Study

The measurement instrument used in the study was a semantic differential questionnaire developed by the Laboratory and based upon work by Charles E. Osgood, George J. Suci, and Perry H. Tannenbaum and described in their text, *The Measurement of Meaning.* The study used responses to the semantic differential as an indication of attitude towards the concepts presented. Osgood, et al., say, "The major properties of attitude that any measurement technique is expected to index are readily accommodated by the procedure. *Direction* of attitude, favorable or unfavorable, is simply indicated by the selection of polar terms by the subject; if the score falls more toward the favorable poles, then the attitude is taken to be favorable and vice versa. A score that falls at the origin defined by "4" on the scales is taken as an index of neutrality of attitude. *Intensity* of attitude is indexed by how far out along the evaluative dimension from the origin the score lies; i.e., the polarization of the attitude score. Although on a single scale, there are only three levels of intensity: "slightly," "quite," and "extremely" in either direction, summing over several evaluative scales yields finer degree of intensity." *(Osgood, 1957)*

The target populations for the Laboratory's training programs are inservice teachers and preservice teacher trainees, but we are also concerned with those persons in positions to make the decision to initiate a training program. Therefore, the populations sampled were elementary and secondary classroom teachers, school administrators, and college teacher trainers. The teachers and administrators were chosen randomly from a list representing a random sampling of schools in the Laboratory's five-state region. College professors in departments of education were randomly selected from a list of all colleges in the region.

A master list of terms relating to behavioral engineering was compiled from recent articles dealing with the topic. Three members of the Laboratory staff independently selected those terms which they considered important to be ranked, and the 24 terms most frequently checked by the three persons were used. The scales were chosen from the Osgood text and represent evaluative scales with greatest purity on dimensions desired for this study. *(Osgood, 1957)*

Results

Question 1: Do educators respond differentially to terms associated with behavioral engineering? If we assume that each individual's ranking is an estimate of the words' true rank order, we can use the rank order of the average rank assigned to words to arrive at our estimate of this true rank. *(Walker, 1953)* It can be assumed that the ranking of the sample repre-

sents the true ranking of terms within the selected populations. The mean response score for all words over *all n* was +1.08 (on a 7 scale of -3 to +3). All groups were the same on relative ranking of words from high to low. The mean scores were averages for *all three* groups, but the same order *held in each group* separately. *(See Table 1)*

square analysis of the variance if there is a difference in how each group scored on the SDQ. *(See Table 2)* When ranking all 24 words together in overall words, chi square was significant at the $p < .005$ level; i.e., there is a 99.5% probability that the three groups are not from the same population, or that they are not the same.

Table 1. EVALUATIVE RESPONSES

Response scores by overall average* in descending order.

Items Above Median Score		Items Below Median Score	
2.34	Individualized Instruction	.98	Behavioral Control
2.18	Independent Study	.82	High Probability
1.90	Classroom Management	.72	Shaping
1.88	Positive Reinforcement	.69	Behavior Management
1.74	Reinforcement	.67	Behavioral Technology
1.71	Team Teaching	.49	Contingencies
1.61	Reinforcing	.37	Operant Conditioning
1.57	Behavioral Objectives	.32	Contingency Management
1.56	Programed Learning	.28	Behavioral Engineering
1.32	Computer	.23	Contingency Contracting
1.24	Behavioral Analysis	.19	Engineering Human Behavior
1.05	Stimulus Control	-.09	Token Economy

*Where scores had a range of -3 to +3 over a 7 space Likert scale.

Table 2

	Professors (n = 37)	Teachers (n = 153)	Administrators (n = 23)	TOTAL (n = 213)
Mean Response Scores*	1.24	1.08	.92	1.08
Friedman Rank Test Scores**	35.5	49.0	59.5	

*Where scores had a range of -3 to +3 over a 7 space Likert scale.
**Where high score was ranked 1 and low ranked 3 across each word. FRT testing of the null hypothesis of: no difference between groups. Significant at .005 level.

Question 2: Are there differences in responses to the terms associated with behavioral engineering among educator groups? Analysis was done by the use of Friedman Rank Test (FRT). This is a null hypothesis test which states that there is no difference between groups on scoring the Semantic Differential Questionnaire (SDQ). The test is a nonparametric analysis to test if the sample groups are drawn from the same population. If all are from the same population, then there should be an equal likelihood of any one group-score being higher than another; i.e., ranking of 1, 2, or 3 on score level should result in each group having an equal number of 1's, 2's, and 3's. The FRT checks the sum of the rank scores for each group and determines by a chi

Inferences

The following inferences can be drawn from the data:

1. There is a generally positive disposition to behavioral management language.

2. Education groups respond differentially to terms related to behavioral management. The classroom teacher's evaluative reaction to behavioral management terms is even more positive than the administrator's but less positive than the university professor's.

References

1. Daley, M. F., "Reinforcement and the Modification of Behavior," *Utah Academy Proceedings.*

2. Hewett, Frank, *The Emotionally Disturbed Child in the Classroom.*

3. Homme, L., "A Behavior Technology Exists–Here and Now." A paper given at the Aerospace Education Foundation's "Education for the 1970's Seminar."

4. Osgood, C. E., Suci, G. J., Tannenbaum, P. H., *The Measurement of Meaning.*

5. Walker, Helen and Lev, Joseph, *Statistical Inference.*

Critical Events in Implementing Behaviorally Engineered Classrooms

Dean A. Honetschlager and Robert H. Pinney

In establishing the Laboratory's 20 behaviorally engineered classrooms, a somewhat complicated job because the classrooms were spread out in four quite different schools in two different states, the Laboratory staff was faced with two broad classes of constraints.

The first class of constraints was imposed by the Laboratory's program. 1) The behaviorally engineered classrooms had to be teacher-implemented and teacher-maintained, and 2) they had to be set up in an on-going school situation. 3) The classroom management system had to include measurement operations for the collection of multiple baseline pupil data, and 4) it could not require structural changes in the room.

Non-program imposed constraints included: 1) the geographical spread of the sites, 2) the diversity of the pupil population, 3) a limited number of Laboratory staff members, 4) skill/knowledge deficiencies in the teacher population, 5) limited financial support from the schools, and 6) the lack of instructional objectives and adequate commercially prepared programed materials.

With these "givens" and the information derived from a detailed deficiency analysis, a flow chart for the effort was developed, critiqued, and revised. *(See fig. 1)* This flow chart reflects the objectives that had to be met in order to insure successful implementation of the new educational system.

As reflected in the chart, the Laboratory staff had to meet six major objectives:

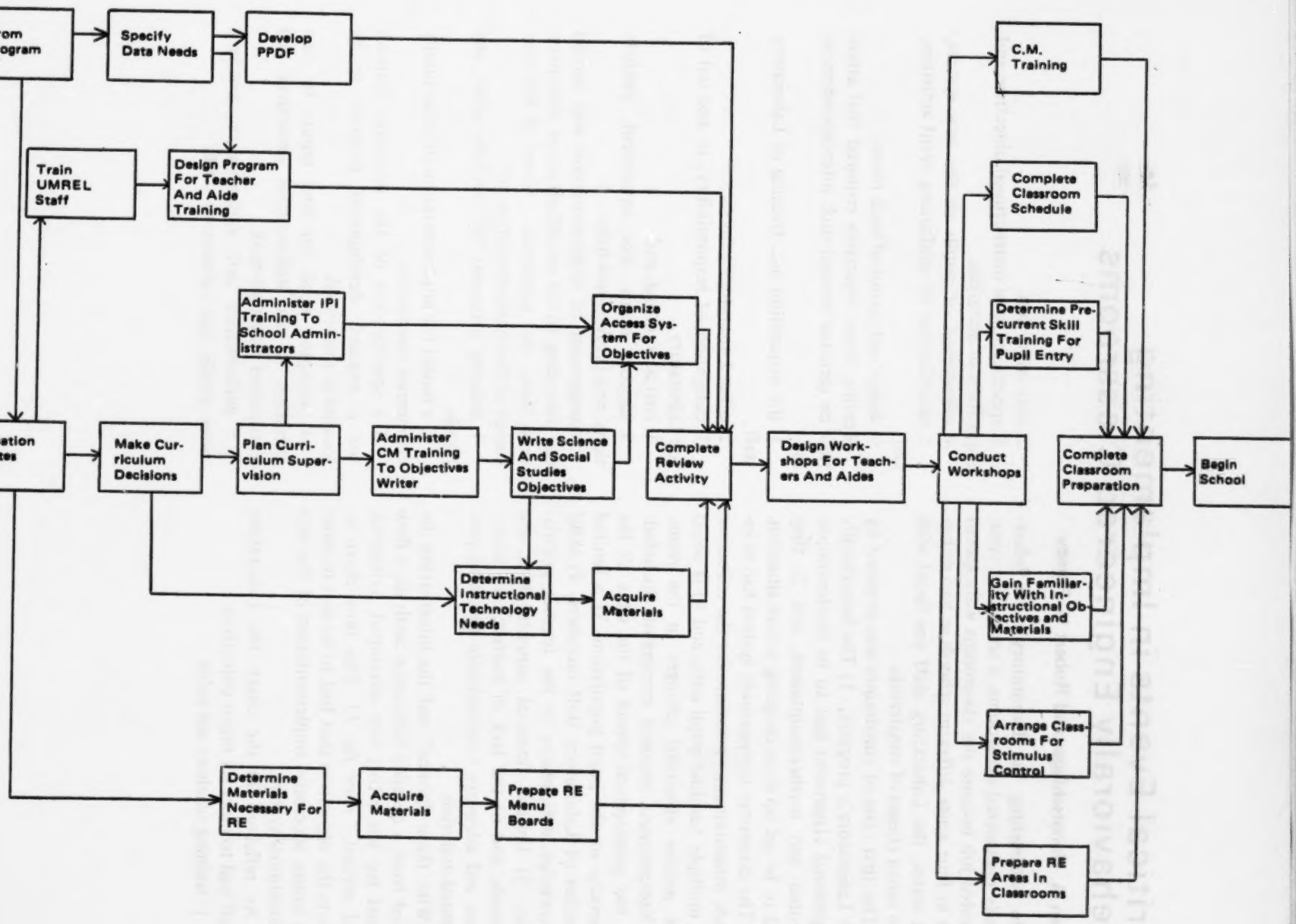
1. training teachers and aides,
2. data collection,
3. specification of instructional objectives and acquisition of materials,
4. orientation of pupils to the new system,
5. specification of reinforcing event activities, and
6. design and layout of each room.

Meeting these objectives required that attention be directed toward such interdependencies as:

1. the acquisition and training of Laboratory staff,
2. other Laboratory activities,
3. delegation of responsibility, in and out of the Laboratory,
4. cost accounting, and
5. support needs, like equipment, publications, non-professional help.

Management of implementation was carried out according to the specifications of objectives, time lines, and personnel. Some of the outcomes of this implementation are:

1. training programs for teachers, aides, and pupils,
2. a model for implementation of behaviorally engineered classrooms,
3. a specification of the necessary features for a research development program to be located in the school,
4. prompted need for first inputs to contribution to an instructional objectives and curriculum materials bank,
5. performance data gathering on teachers, aides, pupils, and Laboratory staff.


From Program
Specify Data Needs
Develop PPDF
Train UMREL Staff
Design Program For Teacher And Aide Training
Administer IPI Training To School Administrators
Organize Access System For Objectives
Evaluation Of Sites
Make Curriculum Decisions
Plan Curriculum Supervision
Administer CM Training To Objectives Writer
Write Science And Social Studies Objectives
Complete Review Activity
Design Workshops For Teachers And Aides
Conduct Workshops
Complete Classroom Preparation
Begin School
C.M. Training
Complete Classroom Schedule
Determine Precurrent Skill Training For Pupil Entry
Determine Instructional Technology Needs
Acquire Materials
Gain Familiarity With Instructional Objectives and Materials
Arrange Classrooms For Stimulus Control
Determine Materials Necessary For RE
Acquire Materials
Prepare RE Menu Boards
Prepare RE Areas In Classrooms

Student Involvement in RE Selection

Gary G. Dodge

Problem. To identify reinforcing events (RE) for use in upper grade self-contained, contingency management (CM) classrooms. After four months' experience with a reinforcing CM system, 6th, 7th and 8th grade pupils still did not have a direct input into decisions about REs available to them in the classroom. A method was sought to investigate student leisure and free time activities to better identify possible reinforcing events for classroom use.

Method. A three-page questionnaire was developed and administered to the class as an alternative to the preferred approach of direct behavior observation. The questions were open-ended and directed at out-of-school activities, favorite games and interests, use of free time in school, spending of money, and suggestions for improvement of the current RE area.

Results. The results are combined for the three grades and are not listed by frequency but by groupings of related activities.

1. Activities

1.1 TV, radio, records, comics, movies, tape recorder, books, magazines
1.2 scrabble, checkers, chess, monopoly cards, sorry, bingo, cribbage, frustration ball, puzzles
1.3 art, draw, paint, sew, cook, type, models, carving, chemistry, electricity, crafts, car and bike repair
1.4 pool, twister game, ping-pong, marbles, jacks, darts, yo-yo, football-hockey games, pin ball type games, slot cars, battling tops
1.5 animals, fish, collections-hobbies, naturalist (leaves, rocks, shells)
1.6 dance, gym, bowl, walk, roller skate, slide, skate, swim, football, bike, sing, camp, hunt, horse, field trips
1.7 food, incense, conversation

2. Environment

2.1 pictures, posters, drawings, black board
2.2 clean, rug, table surface, chairs and pillows
2.3 adequate time, food availability

Discussion. This list provided teachers with a guide for identifying deficiencies in the present RE area. New events could be obtained subject to availability of money, decisions by the class, and acceptability to the teacher.

Problem. The list indicated that more space was needed in the RE area to allow more active events and to increase the number of events available within social, physical, and system constraints. The need for more space led to an analysis of room traffic patterns and storage of materials. This resulted in some decision rules for efficient arrangement of the classroom into task area, progress check area, and RE area:

1. Get multiple use out of shelves, cabinets, movable storage by
   a. using for room dividers
   b. using top also for storage
   c. using as resource material storage
2. Pupil desk placement, task area
   a. place in least active end of room
   b. place backs of chairs against wall to eliminate dead wall space
   c. have no active resource access in desk placement area
   d. have no access aisles through desk area funneling to focal, active access points
   e. place so that visual stimuli is minimized if paper tasks are general routine
   f. place so that 1 to 2 feet separate each desk with no pupils directly facing each other
3. Use unused areas as RE areas, e.g., coat rooms, sinks, normal room egress lanes, dead book storage areas. Use as active RE areas and revert to one-shot use at appropriate

times, e.g., to get coats, to leave room, to use sink

a. attempt to move task area away from these dead areas so that they can be used as RE areas
b. do not be concerned with break up of space as long as RE areas are contiguous and relatively easy to access visually by teacher and aide

4. Teacher desk, active resource material use

a. place centrally with highest used items most easily accessed
b. place near task area with easy teacher control
c. use, if possible, as additional room boundary space definition, e.g., teacher desk placed as task area boundary, resource material near desk
d. separate RE area traffic access from resource area traffic access

Happiness is a Beautiful PPDF

Patricia A. Pool and Chu pin Chu

Shortly before UMREL began to use a revised version of the PPDF, the Laboratory staff checked the acceptability for machine scanning of the data being collected on the old PPDF then in use. This acceptability check revealed that 50% of the PPDFs were meeting the 100% criteria level for correctness of data entries, i.e., dark enough for machine scanning and free of data entry errors.

Machine scanning and computer analysis of pupil performance data (for which properly completed PPDFs should be critical) was scheduled to begin in several weeks, but the Laboratory staff decided that enough time remained to make a *systematic* effort to upgrade data collection on the PPDF.

Since it was likely that the initial acceptability levels for the new PPDFs would fall considerably below the 50% level reached using the old form, the change-over to the new version of the PPDF gave the Laboratory the opportunity to test the effectiveness of procedures for reinforcing teachers, aides, and students for correctly filling out the PPDFs. This approach also enabled the Laboratory to take a pilot step into teacher incentive programs.

Procedures

The basic contingencies were set up as follows: no reinforcement would be given if less than 25% of the new PPDFs were perfectly marked; when 25-49% were perfect, the teacher would get $10 to spend for class benefit; 50-94%: $20 more; 95-100%: $50 more; for a total of $80. The contingency was in effect only for the first week the class met the criterion level. (A class could not earn $10 each week by holding the acceptability level at 25%.)

Decision rules and a training manual were prepared showing the correct way to mark the PPDF, and common mistakes to avoid.

Each individual panel on the PPDF was checked for data entry. Teachers and Laboratory staff responsible for the classrooms were informed of the number and percent of PPDFs which reached 100% acceptability, and of the types of errors made. If one entry rule was violated consistently, the teachers were given an explanation of the specific error and the method of correcting it.

Results

No class reached the 25% level during the first week of the study, but by the fifth week only one class remained below the 25% level, 15 classes had reached the second level, and 3 classes had reached the 90% level. Each week several classes met higher criteria levels.

Notices that they had reached the various acceptability levels were presented to the teachers by the implementors, who also notified the school administrator to release the reinforcement money. (Management by the school administration of a performance contingency fund for teachers is of particular interest because of its relationship to UMREL's school functions analysis.)

The use of the money was controlled by the teacher, who decided how much the aide and students should participate in the purchase of items for the classroom. In the upper grades where the teachers had given the students responsibility for correctly filling out the PPDFs, they also allowed them to decide what to buy with "their" money. Some of the lower grade teachers divided the money in half, spending part for items of interest to the girls, and the other for items of interest to the boys. Some classrooms purchased one or two expensive items—double easel, pool table; others purchased many small items like games and handicraft ma-

terials. One class threw a party and spent the money for refreshments.

Conclusions

1. Use of the training manual coupled with specific reinforcers for properly marked PPDFs appeared successful in upgrading the acceptability for machine scan of data collected on the PPDFs.

Achieving the 50% criteria does not mean that only 50% of the data was usable. Each PPDF contains up to 200 items of data about a student's performance, and each student uses four to six forms per week (one for every curricular area), generating up to 1200 items of data per student per week. If a marked PPDF has only one item missing, incorrect, or incomplete, the whole form is counted as zero for the purposes of this reinforcement plan. A class of 25 students can collect up to 30,000 items of data per week, yet if only 20 of these items are incorrectly marked, the class receives a 50% rating. Clearly the criteria were severely demanding. Nevertheless, by the fifth week 15 of 20 classes were at or above 50%, guaranteeing a massive amount of significant and usable multiple-baseline data on student performance.

2. More detailed preparations should be made before introducing such a scheme to teachers. Although the original idea came from a teacher's suggestion that money for her classrooms would be very reinforcing, this was not true for all teachers. Several reported that receiving money for work which was "part of their job" was degrading. Another thought at first that the money was to be spent only for RE items, and was concerned about having to "earn" funds for an area she considered vital. However, all teachers, when their classes earned the money, were enthusiastic about receiving it.

Videotape as a Classroom Observational Tool

W. Scott Wood and Atlen L. Sova

UMREL has shown that closed circuit television monitoring and videotaping is an effective behavioral observation tool. The Laboratory's technique involves mounting television cameras in individual classrooms, and monitoring and videotaping in a centrally located control room. Behavior in the classroom can be observed by one or more observers, either as it occurs via closed circuit, or later via videotapes made at the same time.

The number of students under observation is determined by the nature of the investigation, the camera's range, and the complexity of the behavior being observed.

There are several advantages to using the videotape observational technique: 1) compared to a classroom observer, the camera is relatively unobtrusive, and quickly becomes ignored by the students, 2) the technique is very flexible, in that *multiple* lenses allow the camera to be focused upon a single student, a small group of students, or the entire classroom, 3) recording is permanent, 4) behavioral observations can be made at any time, by any number of individuals. In addition, the observer can easily "rerun" any questionable portions of the videotape to insure accurate recording, and 5) the method is quite reliable. Use of the overlaid audio pacing tape assures that two or more observers see the same data at the same time, resulting in high inter-observer reliability measures. Table 1 presents the reliability percentages from a series of observations the Laboratory has made using the videotape methodology.

TABLE 1

The percent agreement between two observers scoring the same videotapes. All scoring utilized a time sampling technique whereby each student was observed for a fixed interval during each minute. The "N" column refers to number of opportunities to agree or disagree.

RESEARCH PROJECT	% AGREEMENT	N
1. Study vs Non-Study Behavior (3 students)		
a. at desk	98.5	435
b. writing	82.6	339
c. hand-raised	79.2	25
d. teacher interaction	81.5	27
2. Administrative vs Academic Time (4 students)		
a. at desk	96.1	332
b. completing data form	82.2	157
c. completing study task	92.3	173

One effective technique involves use of the videotape's audio track to record instructions to the observer. For example, while the videotape shows a group of students, the audio track tells the observer which student to watch, how long and what behaviors to record. This kind of recording can be achieved by simultaneously filming the classroom and playing a tape-recorded pacing message onto the audio track. Of course, the audio track can vary in complexity from a simple counting of minutes to a complex sequence of instructions to the observer. These audio pacing techniques are particularly valuable when the data recording method is of the "time sampling" type, where one student is observed for a period of time (usually from 15 seconds to a minute), then a second student, a third, etc.

The cost/effectiveness payoff of the videotape observation procedure increases as the number of *observations* and *observers* increases.

This is a function of:

1. observations not being restricted to the "school day," i.e., delayed observation,
2. reduced travel time and expenses for multiple observers/observations,
3. permanent recording that can be later observed for *other* behavioral information, and
4. being able to train observers "in-house" rather than "in-classroom."

Naturally, the Upper Midwest Regional Educational Laboratory has many uses for equipment of this type, and classroom observation is only one of them. However, this use does help meet the Laboratory's need for a highly reliable, flexible, classroom observation methodology.

A Specific Educational Role for the Classroom Aide

Paul R. Petrafeso

When federal funds were made available to school districts for hiring classroom teacher-aides, administrators and teachers alike hailed the move as a great leap forward in upgrading our educational systems. The use of teacher-aides was seen as an innovation that would give teachers more time for improving their teaching skills, for bettering their curriculum materials, and for helping individual students.

The question should now be asked: "How has the use of teacher-aides affected student performance?" According to statistics from the United States Office of Education, simply using teacher-aides produces no significant change in student achievement. This is particularly true in schools serving disadvantaged populations. Clearly no one thought the use of teacher-aides alone would shore up our sagging educational system, but some benefits were anticipated. What happened?

The teacher-aide programs, like so many other promising innovations, are not at fault; those who implemented the idea should be blamed for any failure. They have usually been guilty of inadequate conceptualization and planning, and the responsibility for the results should rest firmly on their shoulders.

Examine the role of the teacher-aide in the classroom and what do you find? A recent fact-finding tour of nine Indian schools in the Northwest, conducted by the author, uncovered some possible reasons for failure of teacher-aide programs. In the schools studied, aides had been hired with no specific training for their jobs in the classroom. In fact, most never got into the classroom. Many aides were used primarily for odd jobs and errand running, and any training was not preplanned but given only as necessity or crises arose.

The aide's duties seldom had anything to do with improving education. She was kept busy with low-level filing, making posters for display purposes, answering the telephone, helping the cooks, supervising the playground, and in schools where weekly showers were required, she watched over the children in the shower room. If the aide was highly qualified, she did some typing, operated the copying machine, and ran the slide projector, although this job was usually claimed by the audio-visual staff member.

The use of teacher-aides becomes effective only when it is coupled with specific training objectives that result in measurable behavioral outcomes not only for the child, but for the aide and the teacher as well.

In the Laboratory's behaviorally managed classrooms, the teacher-aides are employed and trained to carry out tasks directly related to child learning. This frees the teacher to devote her time to her primary function—individual prescription and instruction. The aide is specifically trained to (1) keep daily records of student progress, (2) evaluate student tasks based on teacher-established criteria, (3) maintain classroom control also based on teacher-established criteria, and (4) maintain the supply of RE items in the reinforcement area.

In addition to these functions, the Laboratory has expanded the role of the aide considerably. Under the Laboratory's program the aides are seen as representatives of the community who make meaningful contributions to the children's education.

The Laboratory's behaviorally engineered classrooms on the Red Lake Indian Reservation, where all aides are members of the Chippewa Indian community, offers an example of this expanded teacher-aide role. Classroom aides like these can provide valuable information regarding what may be reinforcers for these Indian children, or they may act as cultural

reinforcers themselves, strengthening the student's academic performance by their presence and approval.

The Laboratory has shown at Red Lake and its other experimental sites that when aides are assigned specific duties, and are given specific training, they can make an important contribution to the educational process.

Prerequisites for Systems Analysis in Education

William M. Ammentorp, Marvin F. Daley and David N. Evans

Like other applied behavioral sciences, educational administration is beginning to make considerable use of the terminology of general systems theory. The perspectives of systems analysis have much to offer educational administrators, but to produce results, the implementation of systems theory requires full use of the basic conceptual and analytic tools of systems analysis. Intuitive grasp of the method is not enough.

With analytic methods designed to deal with multiple variables, the systems analyst concerns himself with the broad area of decisions and results, concentrating on the basic processes underway in an organization. Shipment of grain to flour mills, maintenance of parts inventory for auto repair, and formal education of children are all processes he can study systematically. For each organization, whether educational or industrial, the analyst considers the output data and its functional relationship to the variables under organizational control.

In a school, the central output datum is change in a child's behavior; the system variables are teacher behavior, subject-matter materials, and reinforcement practices. Following the general stimulus-response-reinforcement learning paradigm, acquisition of a particular behavior by a child is functionally related to conditions of the environment controlled by the teacher. By examining several classrooms, the analyst can determine the three-way relationships between the child's behavior, type of reinforcement activity, and timing and frequency of reinforcement.

Several interlocking administrative roles emerge as systems concepts are applied to an educational organization. Someone must manage the school's daily operation, research must be carried out to evaluate the relationships between variables, and new designs must be developed to meet future educational needs.

The *system manager*, roughly equivalent to the superintendent or principal in traditional school organization, identifies the system's constraints and possibilities: the variables. He locates problems or decision points in organizational activity and selects courses of action.

System researchers assist the manager by feeding information back to him on the likely consequences of his decisions, based on their on-going analysis of the relationships between the system's variables.

The *system designer* combines the data provided by the managers and researchers, with his knowledge of operating systems and processes to produce new designs. His overall view of the process of education makes him a common link for the more practical managing and research roles, and he easily serves as a trainer for these areas.

To function effectively, managers, researchers, and designers should have substantial foundations in systems analysis, along with their understanding of learning and educational theory. The system manager should have skill and experience in identifying variables, planning and flow analysis, and decision-making. These skills could be developed through a basic program of elementary decision theory, and finite mathematics, training him in a logical problem-centered approach to probability and the numerous applications of probability anlaysis beyond simple statistical use. Along with this background, the systems manager should have introductory experience with data systems and planning techniques, acquired through analysis of simple problems using computational aids, and in planning complex activities using PERT or similar techniques. If possible he should follow some elementary work in operations research to facilitate communication with his supporting research operation.

A system researcher needs the same skills as the manager, along with thorough training in

process analysis, similar to that currently offered in federally sponsored programs in educational research.

The system designer must have extensive training in probability analysis and in information and communication theory. He should be aware of any technological and social changes which might influence new system designs, and he must keep abreast of contemporary research on learning as a basic system process.

The manager and researcher function as a management team, dealing with the realities of the particular organizational system and providing data for the designer as he plans new systems; with their perspective, they serve as a reality test for new system designs. The productivity of persons filling all three roles depends directly on their mastery of the tools and methods available for systems analysis. If education is to benefit from systems analysis, educators must have the tools to analyze systems.

The concepts expressed in this paper are further developed in the authors' article in Educational Technology, August 1969.

Inservice Credits as Reinforcement for Teacher Behavior

Rodney L. Snyder

Since teacher behavior and student performance are functionally related, and since the effects of reinforcement on behavior apply to teachers as well as students, it is appropriate to reinforce those teacher responses that result in increased student performance. The Upper Midwest Regional Educational Laboratory has addressed itself to the development of strategies for teacher reinforcement that have the following properties:

1. sequenced behavioral objectives that specify teacher behavior systematically and functionally related to student performance;
2. training and practicum in management skills that lead to teacher attainment of objectives;
3. assessment of teacher performance with student performance as the measure;
4. identification of teacher reinforcers which are practical and useful in the school; and
5. delivery of immediate reinforcement, contingent upon teacher behavior that meets the objectives.

One common reinforcement strategy involves the use of salary-tied inservice credits as reinforcers. Many schools have attempted to develop "good teaching" by reinforcing the teacher's completion of inservice education courses with credits that apply to salary increases. In Minneapolis, where this approach is used, the total annual inservice class enrollment nearly equals the teacher population.

In its efforts in classrooms in the Minneapolis schools, UMREL proposed to use inservice credits to reinforce the specific teacher behavior that affects student performance.

In order to measure the effect of teacher behavior on student learning, an environment has to be established. Teacher acquisition of skills and knowledge requisite to implementing such an environment became the first general objective for which a one credit reinforcer would be delivered.

Secondly, to measure the effect of teacher behavior on student learning, the teacher has to implement and maintain a continuous data recording system on pupil learning behavior. The acquisition by the teacher of requisite data-recording skills became the second general objective for which a second credit reinforcer would be delivered.

Finally, after the establishment of an environment in which continuous data collection on student performance takes place, the teacher would have the opportunity to systematically manipulate variables of her own behavior. The assessment of the effectiveness of such manipulations would be judged by their effect on student performance. A third credit reinforcer would be delivered for self-directed teacher behavior that effects change against baseline in individual student performance.

Each of the preceding three general objectives, comprising complex patterns of behavior, are broken down to specific behaviors, and stated as behavioral objectives. For example, "establishing an environment...." involves functionally arranging the classroom. A specific behavioral objective would be, "the teacher, after completing the instruction in contingency management and after designating an evaluation area in her classroom, will locate the aide's desk so that the aide will have visual contact with the evaluation line, the reinforcement area, and the clock."

Given this level of specificity, teacher's behavior can be measured, and reinforcement can be delivered contingent upon the emission of the behavior.

Since a credit reinforcer can only be delivered after the teacher has met a series of objec-

tives comprising a complex behavioral pattern, intermediate reinforcers in the form of points counting toward the credit will be delivered immediately after the teacher meets each separate objective.

UMREL's initial proposal for this type of reinforcement procedure was made to the Minneapolis Public Schools Director of Staff Development in April 1969. In October 1969 the Minneapolis Inservice Committee approved three inservice credits contingent on the teacher's meeting UMREL's specified objective. The training is elective and open to the teachers of Hay Elementary School in Minneapolis who operate contingency managed classes under the joint sponsorship of the Minneapolis Schools and UMREL.

Establishing Relationships for Research - Based Development in Schools

Dean A. Honetschlager and David N. Evans

Research and development groups which are trying to establish cooperative relationships with schools often find that the usual change models will not work for them. The change models most commonly described in the literature, emphasizing problem identification, resource search, group decision-making, and commitment built through the activities of internal change-agents, may prove inadequate.

Usually in these models, a specific change is sought in one point of the educational system, and little or no attention is paid to the maintenance of continuous change which is necessary in a *development* program. The series of research problems which evolve out of a development program, the interdependencies among the gross variables, and the cost-effectiveness of changes seem to be peculiar to R & D/school cooperative efforts.

The Regional Laboratory requires a relationship with a school which will allow it to make a variety of interdependent well-planned changes in the instructional system. These changes may be unrelated to the immediate needs of the teacher and pupil, and results may have no immediate implications for improving education in that particular school, but the research may be of high significance in extending knowledge about a component of the instructional system, refining theory, or contributing to an understanding of interrelationships. Data are often collected to secure useful information about children's interests and other characteristics, teacher behavior and other phenomena, all of which eventually may bring about better education.

The required changes, research design, data collection procedures, and human interfaces, are determined by the research agency outside the school, and extra demands on the school may be necessary to permit systematic execution of experimental efforts. This obviously means that the people in the experimental situation must agree to perform the prescribed behavior, so that what is designed to be tested will be tested.

It is the Laboratory's experience that school districts and school personnel are willing to participate in change activities which are externally conceived. School governing boards are looking for changes which promise measurably better school experiences for their student population. For teachers and administrators, satisfaction from observable gains in student learning, the excitement of working in an innovative program, the professional relationships with outside consultants, and the attention and recognition by peers and the unusual stream of visitors make the additional effort worthwhile. Many see the identification with potentially successful programs as an important step in career advancement, and they are proud to bring an innovation to their school.

In establishing a relationship with schools, it is important that advantages and constraints be spelled out clearly and are accepted by all parties from the beginning. The Laboratory can offer these assets to the school:

1. A research based innovative instructional system.
2. A measurably better school experience for students.
3. Well-designed retraining programs for teachers and administrators.
4. Continuing public relations assistance with community and parents.
5. Professional personnel to maintain the program and to serve as consultants with the school personnel.
6. Continuing interpretation of progress and findings to the participants.
7. Opportunity to participate in education

research and development of potential high-value and contribution to education.

In achieving a cooperative relationship for conducting research and development, the Laboratory arrives at general agreement of cooperation and monetary commitments with the parent governing board. Then face to face negotiations between Laboratory implementors and school administrators and teachers are conducted.

The following is the set of guidelines upon which discussions leading to a contractual relationship are based. The end result has been satisfactory, cooperative relationships established with teachers and administrators at the four sites which constitute the laboratories for research based development.

Arrangement Necessary at Research and Development Sites

1. Decision-making power shared by the school administrator and the Educational Laboratory in such areas as introduction of special programs, control of visitors and publicity, changes in school schedule, and others to be specified under special conditions.
   a. The School Board, superintendent, and principal should have a thorough first-hand knowledge of the essential elements of the Laboratory's program and objectives. They should be fully informed of the administrative requirements of the program.
   b. There is a significant need for both administrator and teacher retraining when a district participates in the Laboratory's program. The district should be fully aware of the nature and the extent of this training.
   c. Individual school scheduling should provide enough time for teacher data collection.
   d. Introduction of any special education-related program into the school should be cleared through the site coordinating committee.
   e. Visitor policy should be jointly established by administrator and Laboratory so interruption of progress is minimized.
   f. The school principal should be committed to research and development in education and show it through his communications with staff and efficient handling of data collection activities.
2. Permission to modify existing curricular materials and add additional materials.
   a. When curricular material is identified which meets requirements or specified and sequenced instructional objectives, and which is amenable to microtasking and individual evaluation by criteria, the school district will be willing to adopt the curricular material on an experimental basis.
   b. Teachers must agree to follow Laboratory suggestions in use of curricular material.
3. Access to existing test data in school district and permission to test students of the cooperating teachers for academic skills.
4. Permission to collect data and do research.
   a. Permission to use videotape recorders for research and reporting purposes.
   b. Permission to permit research staff members to conduct studies in participating classrooms.
5. Assignment of teachers who are committed to the research and development program in education and willing to accept additional demands placed upon them during their participation.
   a. District should agree to assign teachers to classrooms who are committed to R and D program and willing to assume additional responsibilities.
   b. Teachers should be willing to take retraining on a regular basis while involved in the program.
   c. Teachers should be willing to accept visitors and researchers into their classrooms as part of the normal requirements for participants in the program.
   d. Teachers should be willing to use re-

search model and work with Laboratory staff prior to modifying classroom practices.

e. Teachers should be willing to participate in data collection and reporting efforts.

References

1. Herbert Klausmeir, Richard Morrow, James Walter; "The Multiunit Organization (R & 1 Units) and Elementary Education in the Decades Ahead." In the University of Toledo Elementary Teacher Education Program proposal.

2. University of Pittsburg R & D Center and Research for Better Schools are other organizations which have identified key variables to control for doing research in schools.

Volunteer Programs ?

Robert L. Williams

Volunteers from the community can play a major role in facilitating the operation of behaviorally engineered classrooms, but because of the intricate dynamics of these classrooms, these volunteers should receive special training to develop the skill/knowledge for successfully working in the classrooms. They must be thoroughly familiar with the basic operation of the behavioral management system, especially with coding and other record keeping procedures, supervision of reinforcement practices, and tutorial practices, and they must be keenly aware of their roles as links between the pupil and teacher and between the school and community. They must have an understanding of their potential contribution to the total educational process.

UMREL's experience has shown that selection and recruitment of socially responsible volunteers, should be strongly based on the volunteers' past employment, and on their familiarity with the indigenous community. Because of the complexity of the volunteer's role in the classroom, only those persons should be chosen who can regularly devote relatively large blocks of time to work in the classrooms. Teachers in whose classrooms the volunteers will work should approve all selections.

Once a working list of volunteer resources has been compiled, administrators should clearly delineate the behavioral expectations for the volunteers as they interact with students, teachers, and parents. The necessary training should be carried out by persons well skilled in the principles and applications of behavioral engineering techniques.

Analysis in Elementary School Education

Brian Fitch

As part of the analysis of educational systems an effort is being made to determine what administrative tasks must be performed to support the instructional processes.

One objective of this effort is to identify the functions of administration which are integral to a specified type of individualized instruction. These functions are those interdependent sets of action that must be planned to insure that materials are delivered when necessary, that records are kept, that necessary resources are made available, etc. Once these functions have been identified, it will be possible to delineate the skills and methods to be employed in carrying the functions out.

There are two strategies which can be employed in this process of identification. Using the first strategy, a researcher would perform an inductive analysis of the functions necessary to support the desired system. For this method the major effort would be to conceptualize the system and to determine the constructs of the system accordingly. Interdependencies between separate aspects of the system would appear in theoretical relation to each other and the ideal functions could be hypothesized.

Using the other strategy, the researcher would identify the constraints which exist in currently operating systems. By observing school personnel on the job, it would be possible to note – in a general fashion – how administrative time and effort is distributed. A labeling of categories into which time and effort fall would identify the constraints, or limits, of administration in each school where observations were made. Such a strategy eventually would supply information on which constraints are common to all systems and which are peculiar only to one system.

By employing both strategies, it may be possible to conceptualize necessary functions and then to determine how administrative time and effort is presently being distributed to fulfill these functions. If present activity does not satisfy system needs, administrators can be restrained or technology introduced to deal with deficiencies. Conversely, systems may be revised while on the drawing board to include desirable aspects of present practice. For example, a system can be designed for the procurement and delivery of instructional materials which accounts adequately for every procedural and calendrical requirement. However, if variables dealing with teacher input to the process are not recognized and accounted for in an appropriate fashion and at the accustomed time, delivery may be delayed or the materials not used as anticipated by system designers. When employing both strategies, care must be exercised so that the gathering of data does not prevent change to a different system; data must be used to provide input to, rather than control of, the conceptual design.

Schools, Systems, Machines

Milton C. Hillery, Marvin F. Daley and Robert G. Packard

The role of technology in the education of today and tomorrow is currently a very popular topic. Witness how frequently this subject appears in a wide range of scholarly, and not so scholarly, professional, and not so professional, periodicals and texts. Some writers see massive intervention of technology as the only salvation for a floundering educational institution. Others believe even limited use spells doom for humanism in education–the end of all that is honored and noble in the art of teaching. No matter what the opinion, computers are a fantastic extension of human capability, and many effective uses are possible.

Existing educational computer applications have not been specified by educational institutions. Rather, they are the result of projections by market analysts and the vendors of hardware. Historically, computer sales divisions rushed equipment to school systems to aid operations at subsystem levels, e.g., bookeeping, inventory, scheduling, test scoring, payroll, etc. Computers have dramatically improved the usually inept manual operation of these subsystems, but in the haste to use computers the complex interrelationships of subsystems to the total educational process have been disregarded. The result is a disjointed effort.

A rapidly increasing variety of computer applications are being projected in education today, but unfortunately many have not attacked the basic problem. They have failed to replace fragmented, overlapping and/or discontinuous subsystem applications with a total system application.

The present situation can best be described in terms of the following two deficiencies: 1) education has surrendered to the computer technicians, the responsibility for designing systems and software, though the technicians do not have the professional educational background to accomplish those tasks. 2) computer applications have been limited largely to the fragmented and uncoordinated replacement of clerical services, e.g., inventory, payroll, scheduling, etc. An evolving and integrated total system management has been ignored. This has created the paradoxical situation in which software and local system users dictate what *all* hardware should be able to do, while the vendor decides which specific variations a user can have.

Traditionally, educational management operated in this fashion, requesting computer technologists to provide a service, then sitting back, content to acquire "canned" applications as they became available. The necessary alternative is that management build the internal skills required to manage and sustain a systems approach to management, and then order the hardware that fits the job.

Systems logic at UMREL requires a functions analysis which insures identification of all major functions in a school with enough completeness for informed system design decisions. A reiterative adjustive process is employed as a design moves from analysis to synthesis, and back to analysis, etc. In this way a system can be derived from the system design specifications which clearly articulate the performance limits and procedural, operational, ecological and design constraints. Management planning and control insure that the interdependent parts of the total system are integrated, functional, and relevant.

To accomplish this, UMREL established a working agreement with Biomedical Computer Services Incorporated, a liaison which represents an important contribution of private industry to educational development. BCSI, organized on a logic similar to UMREL's, has applied this strategy to the health care field. Central to BCSI's definition of an effective approach to

the development of a computer utility service is the particular interfacing of professional knowledge and technological skill. Unlike the computer applications referred to earlier, BCSI's leadership and conceptual development is the product of their professional personnel and related technologists who together translate the conceptual model into *operational documentation.*

A significant input in the development of UMREL's "ecological maintenance system" for education has been BCSI's cooperative effort with UMREL in the development of an educational computer utility service, drawing heavily upon the models and procedures established for the health-care system.

In the UMREL-BCSI relationship, locus of control for software and hardware elements have been properly aligned. The user controls system-referenced software while the computer utility service is responsible for the hardware configuration.

This allocation of control insures results that are professionally sound as well as technically proficient, and makes possible management systems that are oriented toward a specific function, but coordinated into an integrated, total systems management computer utility service. The primary source data is identified and then the desired flow and use of that data is arranged to meet the management objective.

In education the primary source data comes from the student, his characteristics and behavior. All systems of an educational institution should be based directly or indirectly on this primary source data, and the management of all instructional and non-instructional subsystems of a total educational system are a logical extension of the student source data. It should be determined what information does, should, or can control behavior within the system; who should receive this information; and what are, should, and can be the consequences of receiving this information.

Systems analysis, documentation, and computer-based information management developed on these parameters of student source data can bring greater coordination to diverse systems functions. The documented flow of information and continuous analytical monitoring of that data and its consequences provides both a) an automatic updating of all subsystems affected by any input of data and b) the generation of tested decision rules which can maximize the effectiveness of information use. All functions in the educational system can be handled in this way. School managers can use the information to decide on the prescription of a learning task for an individual student, the selection of curriculum materials, the physical and geographical specifications for a new building, the cost-benefit analysis of a particular model of personnel use and on and on.

The above leap from the nature of source data to the various outcomes of information management is not an exaggeration, just a simplification of the complex intervening tasks of function oriented systems documentation and related programing. Among these are the identification and development of hardware configuration providing not only computer processing but on-line remote capabilities of input and interrogation as well.

The functions served by the computer and the basic nature of that service are determined by the capacity of the on-site hardware and its accompanying software. Very often the software presents a real problem. Few educational institutions can afford the technological skills of the software analyst and the skilled programer, especially when these costs are added to the cost of leasing or purchasing the hardware component and providing the array of technicians required for operation. However, a well engineered and flexible hardware configuration can economically handle the software variants, and multiple institution utilization maximizes the economical use of the hardware's capacity, subsequently maximizing cost benefits that can accrue to the user.

A computer-based management system of the scope projected by UMREL/BCSI would require technical skills and hardware installation whose initial development costs and subsequent maintenance costs would be prohibitive for most,

if not all, educational institutions. Using the computer utility service concept minimizes the hardware cost and provides a basic system documentation upon which individual users can build, maintain and extend their own variations for only a portion of the initial and usually considerable developmental costs.

An attempt should be made to avoid basing all educational decisions on *only* economic considerations. Political factors, communication problems, individual and group value structures, and local community economics are just a few of the additional considerations. Furthermore, the utility must be capable of changing itself (an adaptive control system) based on new information or breakthroughs in disciplines related to education.

Milton C. Hillery is consulting coordinator for Biomedical Computer Services Inc., 360 Hamm Building, Saint Paul, Minnesota 55102.

Programing for Data Recording

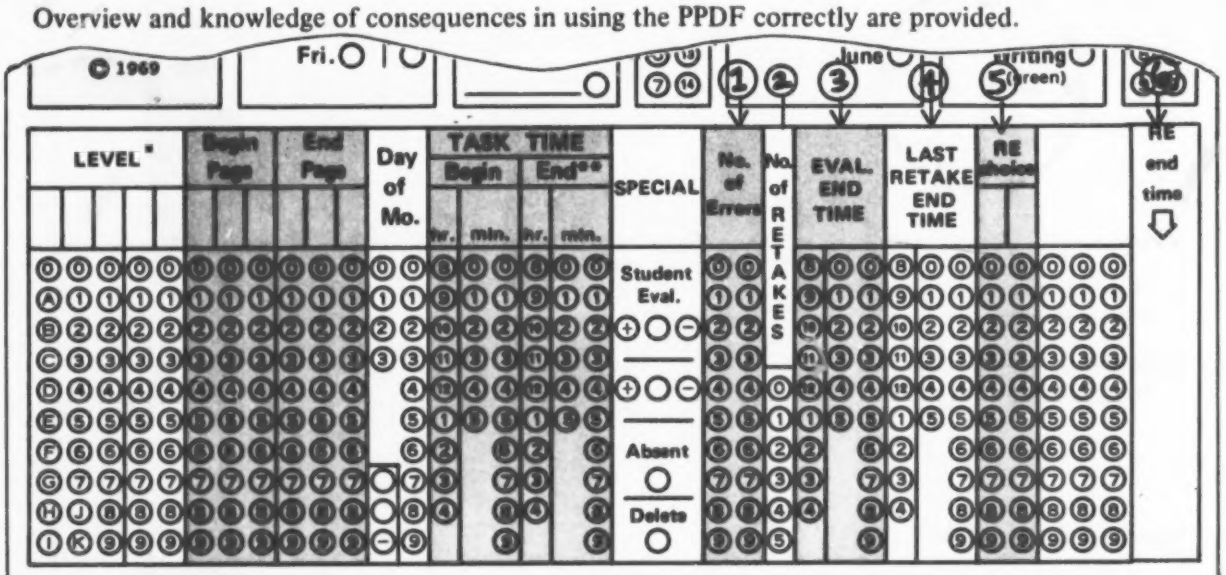
Robert G. Packard

A device for collecting data does not guarantee useful data. If, as is the case with UMREL's PPDF, the device is used by teachers, aides, and elementary students seven hours every day, five days a week, effective instruction in the *use* of the PPDF becomes critical for insuring the validity and reliability of the data.

Instead of more common methods like lectures, demonstrations, or handbooks, UMREL chose a Mathetics model for generating an instructional module for teachers and aides. Among the steps included in this instructional model are these four: 1) perspective, 2) discrimination, 3) sequencing, and 4) transfer, as is demonstrated by the following segments from the programed manual for using the PPDF which was designed for aides.

Perspective

Overview and knowledge of consequences in using the PPDF correctly are provided.



Take a careful look at each of the SIX STEPS:

① ERRORS: how many problems done incorrectly, or not done at all.

② RETAKES: how many times the student went back to correct answers.

③ EVALUATION END TIME: the clock time when you finish correcting the student's work.

④ LAST RETAKE END TIME: the clock time when the student returns from a retake and has 100% correct.

⑤ RE CHOICE: the code number of the Reinforcing Event he chooses.

⑥ RE END TIME: the time when you will call the student out of the RE area and back to his desk for another microtask.

When you correct a paper with a student and record his performance, YOU ARE REALLY BEING A TEACHER, because you are —

a. giving him CREDIT for CORRECT learning,
b. helping him RECOGNIZE and AVOID ERRORS,
c. recording information that is critical to his PROGRESS.

So you can see how important it is to EVALUATE AND RECORD CAREFULLY.

Discrimination

Prerequisite skills and the component skills for recording data are established and strengthened by first demanding the correct responses, then requiring a prompted response by the learner.

GOOD WORK! Easy, isn't it? Let's move on to the next step.

After you have corrected the worksheet, marked No. of Errors and No. of Retakes, then *enter the student's EVALUATION END TIME* from

your watch or table clock

= 8:51

on the student's Data Form:

Notice:

a) There are separate columns for *hours* and for *minutes*.

b) You fill in *one* (and only one) circle in each colum.

Now try this one yourself:

Sally comes to you with her worksheet and data form for her evaluation.

After you finish correcting her worksheet and entering errors and retakes, your clock says:

so you mark

Check your answers

Sequencing

Component responses are integrated in the correct sequence, again by demonstrating and prompting this sequence.

Take a minute to practice numbering the following steps in the order in which you would do them. Presume you have just corrected Mary's work and she has no errors.

_____ a. record the number of the RE she chooses.
_____ b. "What RE did you choose?"
_____ c. "Good work, Mary. Now you can go play with clay."
_____ d. look at your clock and record Evaluation End Time.
_____ e. write the total time on the PPDF in the right margin under RE End Time.
_____ f. add 5 minutes to the present clock time.

check your answers →

Transfer

Transfer of sequenced components to the real demands of the classroom are maximized through graduated levels of simulation. This segment shows the final release which typically follows demonstrating and prompting frames.

Let's take one last quick review over the whole process:

Record the following events in the panel below. (Presume the students are not entering any of their own data.)

IPI Reading, Level E, post-test, page 1, problems 15-30.

You judge that this student will find this work medium-difficult.

Date: Oct. 7. Student begins working on this microtask at 10:15.

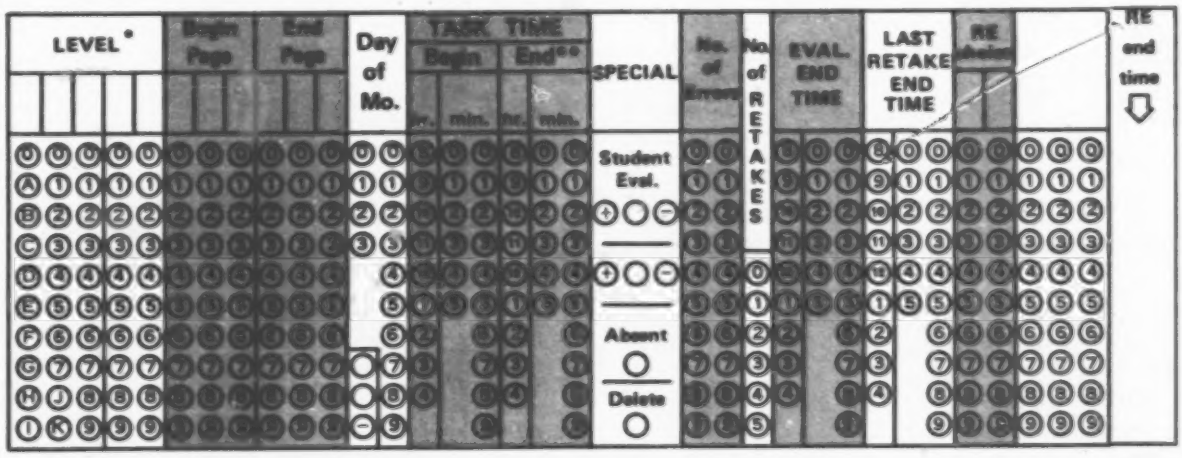
Recess occurs from 10:30 to 10:45.

Student finishes his work at 10:56; he decides the microtask was "not too easy, not too hard."

Evaluation, completed at 11:00, reveals he made 3 errors.

Student returns from reworking the errors, is evaluated, and still has 1 error (time: 11:08).

Student returns with the error corrected (time 11:11) and chooses RE No. 7.



Information Search and Recording System

Judith P. Fitch, William M. Ammentorp, and Marvin F. Daley

The Information Search and Recording System (ISRS) is designed to acquire, classify, and store information relevant to systems engineering in education. An outgrowth of this function is the organization of stored information into annotated bibliographies. ISRS holdings include books, journals, reports, papers, pamphlets, reading review entries (abstracts of literature searches), ERIC microfiche materials and other non-print media. Reporting procedures and management information will be accessed to ISRS this year.

ISRS was developed for the particular needs of UMREL researchers. Its specialized functions are accomplished by several sub-systems:

Address system. All materials accessed to ISRS are addressed by a subject classification scheme (*term framework*) tailored to Laboratory needs. The term framework reflects the program conceptualization and leads its users to think in terms of its categorizations, thus helping to foster similar viewpoints among the Laboratory staff. Procedures for indexing by the term framework and for storing management information, sources of information and support, and reporting methods will be devised and implemented this year.

Reprint request system. ISRS orders reprints of papers and articles at the request of UMREL researchers. This enables staff members to quickly obtain reprints of articles and papers and provides a method of continuously updating ISRS storage.

Reading review entry system. This system provides a standard method of abstracting, recording, indexing, and storing results of literature searches. Weekly lists of reading review entries are sent to staff members, enabling them to stay abreast of current research by reading abstracts of materials, while keeping informed about what other staff members are reading. All staff members are encouraged to read regularly and record information relevant to the Laboratory program; experimental research materials are emphasized.

ISRS training procedures. Staff members were trained in use of the term framework, reading review entries, and ERIC microfiche, indexes, and reader-printer in programed 30-minute training sessions. New staff members are trained individually in the use of total ISRS in programed 60-minute sessions. Trainees are expected to perform specified behavioral outcomes at 100% criterion level. ISRS support staff is trained through use of an operating manual and flow chart of daily activities; these will be programed in the near future.

Literature search system. Annotated bibliographies on subjects relevant to systems engineering in education are frequently prepared and updated by ISRS. ISRS also offers a broad and continuously updated information storage to all UMREL literature searchers. ISRS storage is expanded by interlibrary loan procedures for all libraries in the Twin Cities area, including arrangements for pickup and return of books. Plans for the future include refining of literature search procedures, programing these procedures into flow charts, developing procedures for feasibility studies of literature searches by individual staff members, and devising a method for ISRS to assist and monitor searches.

Current awareness system. All incoming publications are scanned for materials of particular interest to users. These materials are routed to individuals or called to the attention of the entire staff by a current awareness list. Entries on this list are grouped by subject using the term framework, and some are annotated.

Through these sub-systems, ISRS provides for storage and retrieval of information which supports and is generated by program activities.

When reporting procedures and management information are completely incorporated into ISRS, installation of automatic retrieval equipment will be considered. Contact has already been made with several suppliers, but present information needs do not require such equipment. However, because UMREL saw this as a likely possibility, the system procedures and conceptual base are compatible with automatic devices.

ISRS is an unusual effort in the field of educational research because it is specifically tailored to a particular program's information needs. The ISRS model is adaptable to other research and development organizations with different program needs; a detailed explanation of development of the system is available from the Laboratory.

ERIC: A Component of the Information Search and Recording System

Judith P. Fitch

UMREL's Information Search and Recording System (ISRS) is an attempt to provide efficient information retrieval tailored specifically to its organizational, information storage, and program objectives. No national information network can fulfill this function. An information system which attempts to answer the needs of all people in the field of education (e.g., Educational Resources Information Center [ERIC]) cannot provide a common language system of precise terms targeted to research staff of a particular organization. Even educational networks of a more limited scope (e.g., Science Information Exchange [behavioral sciences], ERIC Clearinghouse on Educational Media and Technology) do not use language systems precise enough to meet all the needs of the Laboratory's developmental research.

However, ERIC and other information networks provide excellent support for ISRS when integrated into the system as a component of the information storage. ISRS maintains close contact with the ERIC clearinghouses and frequently obtains newsletters and papers from them. UMREL has a complete collection of ERIC materials which is available to staff members without time-usage restrictions and to the public for limited time-usage in house. ISRS provides a standard abstracting and recording method by which researchers can draw information from ERIC and store it for future retrieval.

All terms in the ISRS subject classification scheme (Term Framework) can be found in the ERIC *Thesaurus;* staff members accustomed to the language system of the Laboratory are able to broaden the scope of their literature searches by referral from one term to another in the *Thesaurus.* In this way ERIC provides a broad base of information, which can be entered by using the *Thesaurus,* in addition to other information stored and indexed by the common language system of ISRS.

UMREL's research staff is trained to use ERIC in a 15-minute programed session. The major portions of the ERIC indexes are explained, and use of the microfiche files and reader-printer is demonstrated. Trainees are then given assignments of documents to be located in the indexes and on microfiche. The intended behavioral outcome is to produce a print-out copy of the microfiche abstract for the assigned document. A one month evaluation following training of the entire staff showed that the ERIC collection had been used by over one-half of the staff.

A training program in the form of a detailed list of procedures is provided for people from outside the Laboratory. A filmstrip-record presentation may also be provided, if usage frequency warrants it. The public is advised to make telephone arrangements in advance of intended ERIC usage.